REPORT #
RRTAC 83-2

The Alberta Government's Reclamation Research Program — 1982

Heritage Fund

Alberta

LAND CONSERVATION AND
RECLAMATION COUNCIL
Reclamation Research
Technical Advisory Committee

Alberta
ENVIRONMENT
Environmental Coordination
Services
Land Conservation and
Reclamation Council

Office of J. M. King, Chairman

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1 April, 1983

Honourable F.D. Bradley
Minister of the Environment
222 Legislature Building
Edmonton, Alberta
T5K 2B6

Dear Sir:

Enclosed herein is the report "Alberta Government's Reclamation Research Program - 1982".

This Program Status Report was prepared by the Reclamation Research Technical Advisory Committee under the direction of the Land Conservation and Reclamation Council.

Yours very truly

J.M. King
Chairman
Land Conservation &
Reclamation Council

JMK:md

Encl.

THE ALBERTA GOVERNMENT

RECLAMATION RESEARCH PROGRAM

1 9 8 2

31 MARCH 1983

Prepared

by

P.F. Ziemkiewicz
Chairman

Reclamation Research
Technical Advisory Committee
of the
Alberta Land Conservation
and Reclamation Council

TABLE OF CONTENTS

	Page
INTRODUCTION	i
LIST OF PUBLICATIONS	ii
RECLAMATION IN ALBERTA	1
THE RESEARCH PROGRAM	1
Plains	2
Mountains and Foothills	7
Northeast Alberta	13
APPENDIX	
Program Summary to Date	18
Location of Field Plots	21
Research Projects 1982-83	22
RRTAC Membership	25

INTRODUCTION

The regulation of surface disturbances in Alberta is the responsibility of the Land Conservation and Reclamation Council. The Council executive consists of a chairman from the Department of the Environment and two deputy chairmen from the Department of Energy and Natural Resources. Among other functions, the Council oversees programs for reclamation of abandoned disturbances and reclamation research. The reclamation research program was established to provide answers to the many practical questions which arise in reclamation. Funds for implementing both the operational and research programs are drawn from Alberta's Heritage Savings Trust Fund.

To assist in technical matters related to the development and administration of the research program the Council appointed the Reclamation Research Technical Advisory Committee (RRTAC). The Committee first met in March, 1978 and consists of eight members representing the Alberta Departments of Agriculture, Energy and Natural Resources, Environment and the Alberta Research Council. The Committee meets regularly to up-date research priorities, review solicited and unsolicited research proposals, arrange workshops and otherwise act as a referral and coordinating body for reclamation research.

Additional information on the Reclamation Research Program may be obtained by contacting:

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Reclamation Research Technical Advisory Committee
Alberta Energy and Natural Resources
9915 - 108th Street
9th Floor, Petroleum Plaza, South Tower
EDMONTON, Alberta
(427-8042)

RECLAMATION RESEARCH REPORTS

Available From: Publication Services
Queen's Printer
11510 Kingsway Avenue
T5G 2Y5 *

1. TITLE: The Alberta Government's Reclamation Research Program 1981, #RRTAC 82-3

   AUTHOR(S): P.F. Ziemkiewicz

   DESCRIPTION: This Report details the Reclamation Research Program indicating priorities, project status, researchers, results and expenditures.

2. TITLE: Manual of Plant Species Suitability for Reclamation in Alberta, 2 Vols. #RRTAC 80-5

   AUTHOR(S): L.E. Watson, R.W. Parker, P.F. Polster

   DESCRIPTION: Forty-three grass, fourteen forb and thirty-four shrub and tree species are assessed in terms of their fitness for use in Reclamation. Information presented includes: Range Maps, Growth Habit, Propagation, Tolerances and Availability.

3. TITLE: Proceedings: Workshop on Coal Ash and Reclamation. #RRTAC 81-3

   AUTHOR(S): P.F. Ziemkiewicz, R. Stein, R. Leitch, G. Lutwick

   DESCRIPTION: Presents nine Technical Papers on The Chemical, Physical and Engineering Properties of Alberta Fly and Bottom Ashes, Revegetation of Ash Disposal Sites and Use of Ash as a Soil Amendment. Workshop discussions and summaries are also included.

4. TITLE: 1980 Survey of Reclamation Activities in Alberta. #RRTAC 81-2

   AUTHOR(S): D.G. Walker, R.L. Rothwell

   DESCRIPTION: This survey is an update of the original Report conducted in 1976 on Reclamation Activities in Alberta, includes Research and Operational Reclamation, locations, personnel etc.

5. TITLE: A Bibliography of Baseline Studies in Alberta: Soils, Geology, Hydrology and Groundwater. #RRTAC 82-2

   AUTHOR(S): C.G. Powter, H.P. Sims

   DESCRIPTION: This Bibliography provides baseline information for persons involved in Reclamation Research or in the Preparation of Environmental Impact Assessments. Materials, up to date as of Dec. 1981 are available from the Alberta Environmental Library.

6. TITLE: Proceedings: Workshop on Reconstruction of Forest Soils in Reclamation. #RRTAC 80-4

   AUTHOR(S): P.F. Ziemkiewicz, S.K. Takyi, H.F. Regier

   DESCRIPTION: Experts in the Field of Forestry and Forest Soils Report on Research relevant to Forest Soil Reconstruction and discuss the most effective means of restoring forestry capability of mined lands.

7. TITLE: Land Surface Reclamation: An International Bibliography 2 Vols. #RRTAC 82-1

   AUTHOR(S): H.P. Sims, C.B. Powter

   DESCRIPTION: Literature pertinent to Reclamation in Alberta is listed in Vol. I and is also on the University of Alberta Computing System. The keyword Index and Computer Access Manual comprises Vol. II

8. TITLE: The Role of Organic Compounds in Salinization of Plains Coal Mining Sites #RRTAC 80-3

   AUTHOR(S): N.S.C. Cameron et al.

   DESCRIPTION: This is a literature review of the chemistry of sodic mine spoil and the changes expected to occur in groundwater.

* A $5.00 fee is charged for each publication to cover handling and postage.
Please make cheque payable to: "Provincial Treasurer of Alberta.

RECLAMATION IN ALBERTA

Most of Alberta's industrial activity occurs in three major biophysical regions: The Plains, where most of the Province's agricultural land is located, the Mountains and Foothills where recreation, forestry, wildlife and watershed values are predominant, and Northeast Alberta, where wildlife and forestry values exist.

Coinciding with these regions are three major disturbance types:

1) Plains: Coal mines operated in conjunction with electrical generating plants,
2) Mountains and Foothills: Metallurgical coal mines and high quality thermal coal for export, and
3) Northeast Alberta: Oil sand mining and extraction facilities.

While it is expected that research results will often have province-wide application, the division of the program among the three biophysical regions has proven helpful in identifying priorities and directions for the research program.

THE RESEARCH PROGRAM

Following is a summary of research projects as of March, 1983. Project titles are followed by the names of the principal investigators and their affiliation.

Upon project completion a final report is submitted. Some final reports are published intact as RRTAC Reports and released to the public. Others are held pending their inclusion in comprehensive reports. A list of available publications is included on Page ii.

I. PLAINS

Reclamation Objectives

To return crop land to pre-mining levels of productivity. Productivity is taken to include both agricultural and hydrologic capabilities.

The Problem

Plains coal seams are usually overlain by bedrocks which contain a high proportion of swelling clays. When exposed to the elements the bedrock shales and sandstones break down into a material that is sticky when wet and very hard when dry. This severely hinders plant growth and agricultural operations. Above the bedrock lie glacial deposits which are usually free of the most adverse properties of the bedrock though they lack the plant nutrients and organic matter characteristic of the overlying topsoil.

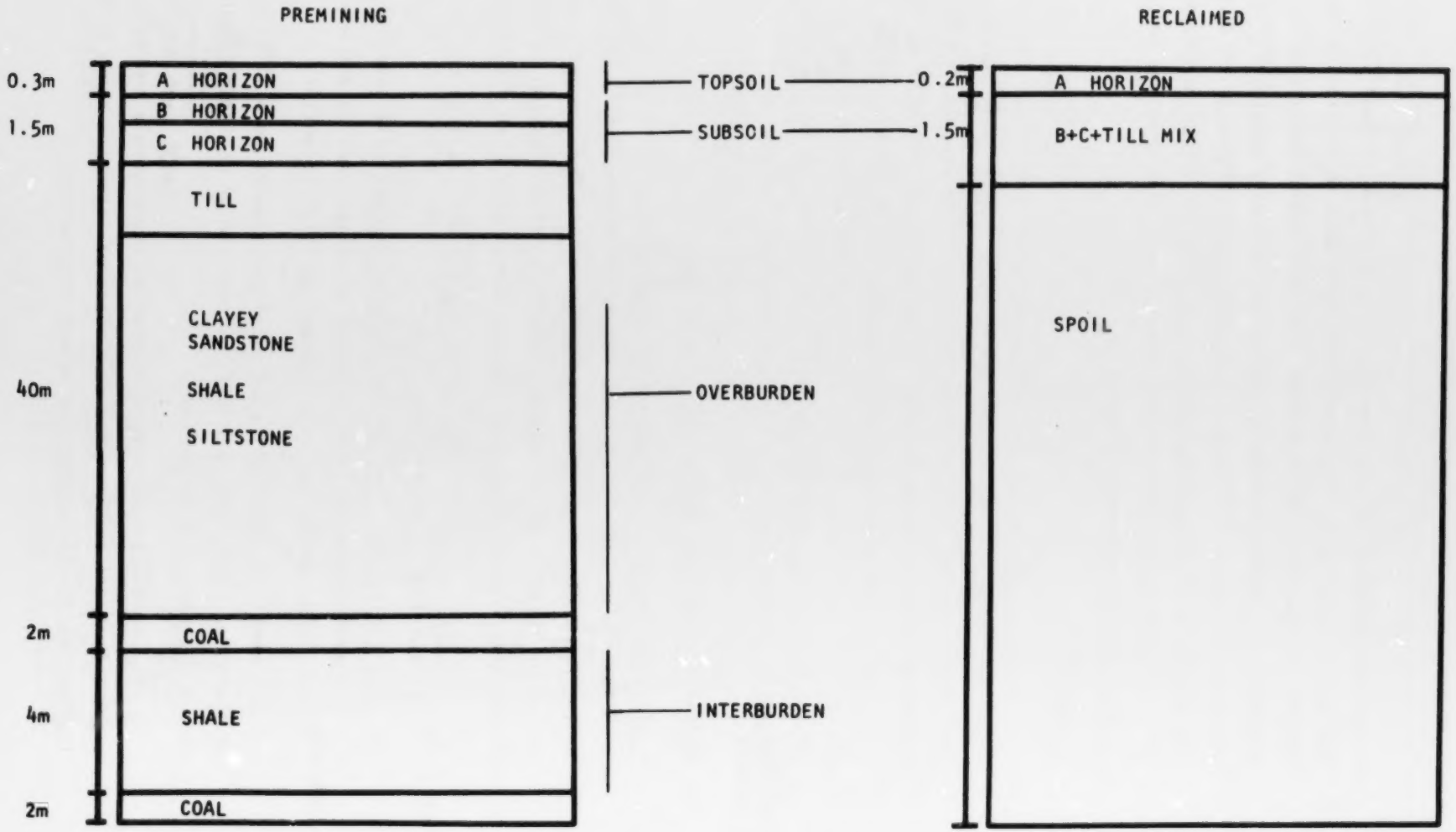
Rebuilding a soil profile is one of the major problems in cropland reclamation in Alberta. A soil must be built on levelled overburden which will be as productive as the original soil. Existing evidence indicates that placing topsoil and a buffering material over the spoil is the most efficient method for achieving this goal. However, we do not know how much capping material is needed. Also, where topsoils or subsoils are in short supply other amendments may be useful in soil building. In addition to soil reconstruction certain agricultural practices like green manuring and legume cropping may help rebuild the soil (Figure 1).

In many plains areas the coal seams are the major source of domestic water. What will happen when the coal is removed and overburden fills the mined-out pit? The behavior of the post-mining groundwater system will affect water users and could influence future agricultural potential. However, little is known about the effects of surface mining on groundwater in Alberta.

Mining on Agricultural Land

Cropland is surface mined in two major zones in Alberta: The Ardley Zone running southeast from Mayerthorpe to Red Deer and the Horseshoe Canyon Zone

FIGURE 1 — GENERALIZED PROFILES



which runs parallel and to the east from Barrhead through Camrose to Drumheller. The Ardley Zone is surface mined near Lake Wabamun to provide coal to the Wabamun and Sundance power plants. Two additional power plants, Keephills and Genessee are presently under construction and will extend mining southward to the town of Genesee. The Horseshoe Canyon Zone is mined on either side of the Battle River between Forestburg and Halkirk. These mines supply the Battle River Generating Station. Another power plant and mine are being developed to the south at Sheerness (Figure 2).

Approach

Mining in the Ardley and Horseshoe Canyon Coal Zones involves two different sets of soils, overburden and climate. Also, soil reconstruction and groundwater cannot be studied in isolation. For example, if after mining a saline watertable re-establishes within a foot of the soil surface the topsoil, regardless of it's original quality, will quickly become unsuitable for crops. So in both the Ardley and Horseshoe Canyon Zones we are identifying the best methods of reconstructing soils and at the same time we are studying what happens to the groundwater after mining.

A) RECLAMATION OF COAL MINED LAND

Plains Coal Reclamation Research Program

The Plains Coal Reclamation Research Program (PCRRP) has been designed by the Provincial Government and members of the Coal Industry to answer questions relating to groundwater and soil reconstruction in both of our Plains Coal Mining Zones. Two main projects have been established:

1) The Plains Soil Reconstruction Project will tell us how to rebuild agricultural soils after mining and
2) The Plains Hydrology and Reclamation Project will describe what happens to groundwater during mining and after reclamation and how to rebuild the landscape to maximize the agricultural potential.

By combining the results of these experiments we will develop a picture of how mined landscapes work and how they can be designed to ensure the return of their original values.

These projects are installed both at the Highvale and Battle River mining areas. Both are designed for five years of intensive study with the possibility for further monitoring beyond that period.

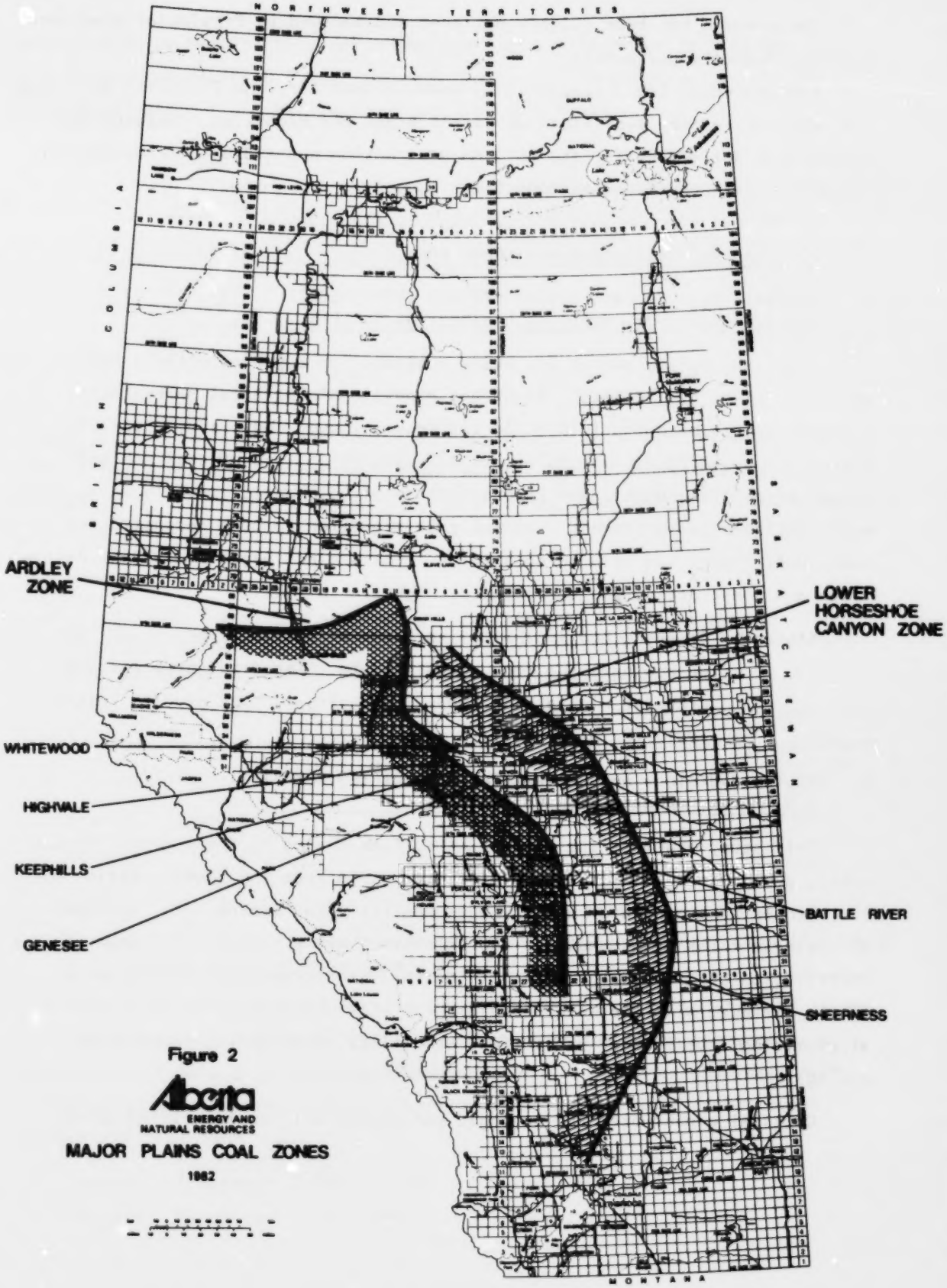


Figure 2

Alberta
ENERGY AND NATURAL RESOURCES

MAJOR PLAINS COAL ZONES

1982

The program has been jointly designed and managed by Provincial Government and Coal Industry personnel.

Alberta Power Ltd., Luscar Ltd., Manalta Coal Ltd. and TransAlta Utilities Ltd. constructed the Test Plots at Battle River and Highvale. Research and maintenance activities for the Soil Reconstruction and Hydrology Programs are supported by the Heritage Savings Trust Fund.

1. Battle River Soil Reconstruction Project (82-5-LES)
   L.A. Leskiw, Pedology Consultants Ltd.

2. Highvale Soil Reconstruction Project (82-13-SCH)
   A.E.A. Schumacher, Montreal Engineering Co. Ltd.

Grain and forage yields are being evaluated on a series of soil reconstruction plots at the Battle River and Highvale Mining Areas. Treatments include: depth of subsoil (0 to 3m thicknesses) over sodic spoil, use of bottom ash as an impediment to upward salt migration, use of coal ash and gypsum as soil amendments and reconstruction of solonetzic topsoils using different horizons and mixtures. Lateral salt migration through reconstructed soils over spoil slopes is also being studied. The project began in 1979 at Battle River and construction was completed at Highvale in 1982.

Status: Cropping and Soil Sampling began at Battle River in 1981 and we now have two crop years of data. The first crop will be grown at Highvale in 1983. Each site will be studied intensively for at least five years.

3. Plains Hydrology and Reclamation Project (79-2-MOR)
   S.R. Moran, Alberta Research Council

This study examines the impacts of surface mining on the regional groundwater, geology and soils. The main objectives include the identification of: 1) changes in groundwater quality and quantity after mining, 2) sources and release rates of groundwater contaminants (mainly salts), 3) changes in distribution of groundwater after mining (will the groundwater carry salts to the surface, will the watertable drop or will the watertable re-establish at premining levels) and 4) surface stablility after mining (subsidence, piping).

Critical groundwater and geologic parameters will be identified which

may allow us to predict the "reclaimability" of a site prior to mining. This project began in 1979 and, like the Plains Soil Reconstruction Project it is duplicated at the Battle River and Highvale Mines.

Status: Battle River monitoring equipment is in place and the detailed soil survey has been completed. Two years of hydrologic data have been collected north of the Battle River, and one year on the south side.

Highvale - Installation and monitoring began in 1982. Each site will be intensively monitored for at least five years.

4. Physical and Chemical Changes in Stockpiled Topsoil (79-26-FUJ)
J. Fujikawa, Technical Development Branch, Alberta Environment

A topsoil stockpile near Bow City, Alberta, is being monitored along with undisturbed topsoil to determine whether adverse changes occur during storage. Ultimately this line of research will indicate how long topsoil can be stored before deterioration occurs.

Status: Ongoing

5. Contribution of Groundwater Organic Compounds to Salinization in Plains Surface Mining (79-22-HOD, 79-27-HOD)
G.W. Hodgson, University of Calgary

These projects examined the organic chemistry and microbiology of mine spoil salinization and were instituted to complement the inorganic chemistry approach taken in the Plains Hydrology Reclamation Project.

Status: Completed

Results: Final Reports 79-22-HOD, 79-27-HOD

B) PIPELINES

6. Evaluation of Pipeline Reclamation Practices on Agricultural Land (81-1-HAS)
W.J. Hastie, Hardy Associates (1978) Ltd.

This study addressed the effects of construction and reclamation of three pipeline sizes: 56", 36" and 10". A description of the major types of pipeline construction and reclamation techniques will be prepared and their difference relative to surface disturbance noted for various soil zones, types, and agricultural land uses.

Status: Completed 31 March 1982

Results: Final Report 81-1-HAS

C) FLY & BOTTOM ASH DISPOSAL

Four studies were conducted to characterize Alberta Coal Ashes and to assess their effects on soils and crops.

7. Chemical Characterization of Bottom Ash and Fly Ash from four Alberta Power Stations (78-2-MCC)
D. McCoy, Technical Development Branch, Alberta Environment

8. Plant Nutrient-Agronomic Potential of Coal Ash (78-20-MCC)
D. McCoy, Technical Development Branch, Alberta Environment

9. Radioactivity in Fly Ash (80-19-MCC)
D. McCoy, Technical Development Branch, Alberta Environment

10. Physical and Chemical Characterization of Fly Ash (78-5-P/R)
D. Pluth, J. Robertson, Soils Dept., University of Alberta

Ash samples were collected over a period of time and analysed to determine if fly and bottom ash chemistry varied among the various coal seams and power plants, and whether ash from a given source varies significantly through time. Various rates of fly ash and bottom ash were mixed with two soils and a sodic spoil to determine whether ash addition can enhance growth of barley and alfalfa. Levels of radioactivity in fly ash from several power plants in Alberta were surveyed. Fly Ash from five sources around Alberta were surveyed for physical and chemical properties. Plant toxicities were evaluated in greenhouse studies.

Status: Completed

Results: Published in Report #RRTAC 81-3

11. MOUNTAINS AND FOOTHILLS

Reclamation Objectives

1) Control of erosion on a wide variety of disturbances including coal mines, mineral exploration sites, coal ash pits and oil and gas well sites.
2) Return of forested lands to previous levels of productivity.
3) Return of wildlife range to previous levels of productivity.

The Problem

Reclamationists in the mountains and foothills face a wide variety of conditions. While some foothill sites are characterized by subdued terrain and moderate climate other sites, particularly in the mountains, present steep slopes, rocky spoil and a short growing season. On these problem sites summer droughts, chinook winds, erodible slopes and nutrient-poor soils are common.

On lower elevation foothill sites reclamation is expected to yield forests with commercial potential while on the higher elevation mountain sites erosion control, development of wildlife habitat and recreation potential are the reclamation objectives.

Reclaimed land in the mountains and foothills will not be as intensively managed as reclaimed agricultural lands would be. Also, topsoils and subsoil layers tend to be thin and difficult to handle selectively. They nonetheless are a valuable source of plant nutrients. So while some mixing of horizons is inevitable how much is acceptable? How thick should the replaced soil layer be? Other sites simply have no salvageable topsoil and Reclamation must prepare the site so that a plant-soil system will develop which will perform its land use expectations without indefinite fertilization.

A) LANDSCAPE DESIGN

One of the most important aspects of Reclamation in the Mountains and Foothills is creation of stable reclaimable landscapes. This includes dump design (optimal slope angles and lengths, terracing) and pit backfilling. Another critical aspect of landscape design involves the creation of new watersheds. These must be designed to control water flows and siltation of surrounding waters.

1. Mountain and Foothill Dump Design (82-14-CHO)
R.G. Chopiuk, Coal Mining Research Center

Resloped overburden dumps in Alberta and British Columbia were surveyed to identify practical construction and resloping strategies.

Status: Ongoing

Results: Annual Report 82-14-CHO

B) SOIL RECONSTRUCTION

Soil Reconstruction in the Mountains and Foothills involves making the best use of limited soil materials. The objective is to improve the Root Zone over Rocky and Nutrient-Poor Spoils. At Grande Cache coal ash disposal sites must be revegetated with implications for building a soil on the ash surface.

Of particular interest is the reinstatement of commercial forest capability on mined land. Two test plots have been established in the Foothills by Luscar Ltd. and Union Oil of Canada Ltd. which compare various thicknesses and blends of soil materials for commercial tree growth. These projects were developed in consultation with RRTAC and are supported entirely by company funds.

2. Revegetation of Ash Disposal Sites, Grande Cache (79-1-MAC)
T.M. Macyk, Alberta Research Council

This project identified the thickness of capping material over coal ash required to support an erosion-controlling cover crop. This is a co-operative Project with McIntyre Mines Ltd.

Status: Completed

Results: Final Report 79-1-MAC

C) REVEGETATION

Reclamation programs may have several objectives in the Mountains and Foothills including development of forestry capability, wildlife habitat and watershed values. Our objective is to develop revegetation methods which will meet objectives without long-term maintenance. Within the revegetation problem area priorities have been identified for herbaceous cover (species selection, erosion control, fertilization, nutrients) and for shrub and tree cover (propagation, establishment).

SPECIES SELECTION

3. Selection of Native Grasses for Reclamation (79-7-WEI)
J. Weijer, University of Alberta/A. Naeth, Alberta Environmental Center

Many alpine and subalpine sites are difficult to reclaim simply because commercially available grasses and legumes either cannot survive or reproduce in the short growing season. This study is selecting lines of native grasses which are known to invade disturbances in the subalpine and alpine. Selections are made on the basis of commercial potential and fitness for reclamation.

Status: Ongoing, the Project has been transferred to the Alberta Environmental Center, Vegreville.

Results: Three lines of Agropyron species are presently undergoing testing for licencing application with the Canadian Department of Agriculture.

4. Native Grasses for Reclamation: Selected Line Adaptability Trials (79-23-WEI)
P. Ziemkiewicz, Alberta Energy and Natural Resources

By early 1979 the above study had produced nine selected lines of native grass species. To ensure that the selected lines had not lost their tolerance to high-elevation conditions in the process of development, a series of test plots was established: 1) to evaluate their fitness to subalpine and alpine conditions, 2) to compare their performance with selected agronomic grasses and 3) to evaluate their respective fertilizer requirements.

Status: Ongoing

Results: Report #RRTAC 80-1

5. Evaluation of Native-Agronomic Grass/Legume Mixes for Reclamation of Subalpine Disturbances (78-18-RUS)
H. Tomm, Alberta Forest Service

Certain agronomic grasses and legumes are known to quickly establish an erosion-controlling cover while native grasses generally grow more slowly. This experiment tests which of several native/agronomic seed mixes provides the best combination of erosion-control and long-term stability.

Status: Ongoing

6. Survey of Alberta Forest Service Native Grass Trials (82-12-TOM)
M. Mihajlovich

Between 1975 and 1977 a number of Test Plots were established in the Mountains and Foothills from Alpine to Boreal Forest conditions. Native Grass, Tree and Shrub container plantings were tested as well as various topsoiling

treatments. Other treatments included island transplants and various agronomic legumes. This study was undertaken in 1982 to: 1) Document the location of the Plots and 2) gather and synthesize all available information.

Status: Completed

Results: Final Report #82-12-TOM

EROSION CONTROL

7. Methods for Establishing Grass Cover on Unamended Coal Spoil (80-11-TAK, 79-17-TAK)
S.K. Takyi, Alberta Forest Service

This study compares different seedling methods for native grass mixes (hydroseeding, broadcasting and raking, simulated drilling). Also various erosion-controlling mats, mulches and contouring treatments are evaluated.

Status: Ongoing

Results: ENR Report #152

8. Survey of Alberta Forest Service Reclamation Sites (78-1-LAR)
G. Laroi, University of Alberta, Forest Science Department

Reclamation roads and drilling sites were surveyed in 1978 to assess revegetation success 4 to 7 years after treatment. Permanent sampling plots were established which may be reassessed in the future to better understand plant succession on reclaimed sites.

Status: Completed

Results: Final Report 78-1-LAR

FERTILIZATION, NUTRIENTS

9. Factors which Accelerate Development of Stable Nutrient Cycles (82-11-Z/T)
P. Ziemkiewicz, S.K. Takyi, Alberta Energy & Natural Resources

The effects of Topsoiling, Species Selection (Native vs Agronomic, Grass vs Legume) and Maintenance Fertilizer Regime are evaluated on a Subalpine Coal Mine with regard to plant development, distribution, uptake and cycling of nutrients.

Status: Ongoing

10. Survey to Determine the Occurrence of Microbial N-fixing Root Sheaths (79-8-L/R)
M.J. Rowell, Norwest Soils Ltd.

Preliminary work suggested that root sheaths may be a significant source of N-fixation for grasses growing in nutrient-poor soils. This survey was commissioned to look for root sheath occurrence on reclaimed and undisturbed areas. Correlations were made between plant vigor and root sheath occurrence. N-fixing rhizosheaths were found on grasses growing on disturbed sites more commonly than on undisturbed sites. Future work may involve isolation and identification of the N-fixing organisms. When available, the resulting inocula would be tested under field conditions to determine whether they have value as a reclamation treatment.

Status: Completed

Results: Final Report 78-8-L/R

11. Uptake of Nitrogen by Native Grasses (78-3-M/P)
D. Paton, University of Alberta

It is often assumed that native grasses require less nutrient than their agronomic counterparts. This study compared the nitrogen uptake rates of native and agronomic grasses to learn more about their nutrient requirements.

Status: Completed

Results: Final Report 78-3-M/P

TREE & SHRUB PROPAGATION

12. Native Shrub Seed Propagation Testing Project (80-16-KIN)
P. King, Alberta Forest Service

Methods for collecting, handling and treating seed of native shrub species with potential for reclamation will be evaluated to maximize propagation success.

Status: Ongoing

13. Factors Affecting Germination of Buffaloberry (82-1-K/H)
C. Keating, University of Alberta, Forestry Department

Buffaloberry (Shepherdia canadensis) is a valuable shrub for Reclamation, but it is difficult to propagate. This Study investigated methods for enhancing germination of Buffaloberry seed so that stock may be produced in large quantities for Mine Reclamation.

Status: Completed

Results: Final Report 81-1-K/H

TREE & SHRUB ESTABLISHMENT

14. Optimization of Erosion Control and Reforestation Potential of Reclaimed Areas (79-16-MIH)
P. King, Alberta Forest Service

This study will identify the level of grass/legume cover which will prevent erosion yet permit tree seedling growth. This study will also identify methods for predicting the optimal levels of herbaceous cover.

Status: Ongoing

III. NORTHEAST ALBERTA

Reclamation Objectives

1) To develop techniques whereby a self-sustaining, erosion-free cover can be established on oil sand tailings pond dykes.
2) To return tailings sand storage and overburden dumps to productive forest.

The Problem

Northeast Alberta contains all of Canada's surface-mineable oil sands. Extraction of this valuable petroleum resource presents several problems for reclamation. By far the greatest problem lies with the tailings disposal systems currently employed.

At the end of its 25 year life a typical oil sand plant producing 19 900 cubic meters per day (125 000 barrels per day) of synthetic crude oil will require a 22 to 31 square kilometer (8.5 to 12 square miles) tailing pond. The liquid contents of the pond will consist primarily of 360 million cubic meters of sludge. The sludge will remain in a liquid state indefinitely and will be impounded behind dykes built of tailings sand. Dyke heights will reach from 55 to 100 meters above ground level. Erosion protection will be provided by a cover of grasses, legumes and shrubs. Because the tailings sand is devoid of nutrient and drains rapidly, amending materials (Muskeg, certain mineral overburdens) will be added to begin development of a soil.

Pits left after mining will be filled with tailings sand and overburden dumps will be constructed. These sites will also be reclaimed to a designated land use. Soil reconstruction and woody plant establishment in particular need further research.

Approach

As in the Mountains and Foothills, proper reclamation in Northeast Alberta will produce landform and plant community combinations which will fulfill their land use requirements without indefinite maintenance.

In order to pool resources and avoid duplication of effort, RRTAC and the industry's Oil Sands Environmental Study Group (OSESG) have initiated a joint Reclamation Research Program. Three priority areas have been identified: 1) Woody Plant Research 2) Soil Reconstruction 3) Equipment Development.

The Woody Plant Research Program is now underway and test plots for the Soil Reconstruction Research Program will be constructed in 1983.

A) SOIL RECONSTRUCTION ON TAILINGS SAND

1. Soil Reconstruction Project: Phase I Literature Review (79-24-OSE)
   R. Johnson, Montreal Engineering Co. Ltd.

This was a joint OSESG/RRTAC project aimed at identifying available soil-building materials in the Oil Sands area and developing methods of combining these materials into productive soils. Phase I, which is a literature review and analysis of existing information was funded in 1979/80. This review identified treatments for the Test Plot Program which will constitute Phase II of the Soil Reconstruction Project.

Status: Completed

Results: Final Report 79-24-OSE

2. Reinstatement of Biological Activity in Reconstructed Soils (81-3-PAR, 78-4-PAR)
   D. Parkinson, University of Calgary

The nature of micro organism establishment on reconstructed spoils was investigated in a series of field and laboratory studies. Emphasis centered on Fungal Decomposers and Micorrhizal Fungi and the influence of various amendments (peat, sewage sludge, inorganic fertilizers) on their populations.

Status: Completed

Results: Final Report 78-4-PAR, 81-3-PAR

3. Micorrhizal Potential in Reconstructed Soils (81-2-PAR)
   D. Parkinson, University of Calgary

Micorrhizal Fungi nearly always enhance tree nutrition. This project will determine the survival and inoculum potential of Micorrhizal Fungi in undisturbed and stockpiled peat to be used in oil sand tailing reclamation. Also, Fungal species will be selected for use in Jack Pine inoculation programs and micorrhizal development will be monitored in field trials.

Status: Ongoing

B) REVEGETATION

Revegetation in the Oil Sands will focus on establishing shrubs, commercial and non-commerical tree species and in some areas a grass-legume cover for erosion control. The latter is readily accomplished so the Revegetation Research Program concentrates on establishment of shrubs and trees.

4. Selection of Tree and Shrub Varieties for Oil Sand Reclamation (79-13-DUN)
S.K. Takyi, P. King, Alberta Forest Service

In 1979 a test site in the oil sands area was planted with varieties of native and exotic tree and shrub species to help select those most suitable for oil sands reclamation.

Status: Ongoing

5. Survey Establishment and Maintenance Procedures (81-4-P/F)
R. Hermesh, Techman Engineering Ltd.

6. Review of Propagation Methods (81-5-WAT)
R. Hermesh, Techman Engineering Ltd.

7. Seed Collection for Shrub & Tree Trials (81-6-K/K)
D.J. Klym, Suncor Inc., P. King, Alberta Forest Service

8. Review of Sampling Methods (81-7-ROW)
M.J. Rowell, Norwest Soils Ltd.

These four Projects were preliminary to establishment of Field Trials in 1983. All were jointly supported by OSESG and RRTAC.

Status: Completed

Results: Final Reports: 81-4-P/F
81-5-WAT
81-6-K/K
81-7-ROW

IV GENERAL

A number of projects will yield results applicable to reclamation problems throughout Alberta. These projects are listed below.

Projects

1. Reclamation Review (78-6-SIM)
   H.P. Sims, Alberta Environment

This project will compile information from the international reclamation literature pertinent to Alberta. The Reclamation Review will not only serve as a handbook of reclamation techniques, it will also identify gaps in our reclamation knowledge and point the way for future research.

Status: Bibliography Completed

Results: Published Report #RRTAC 82-1

2. Reclamation Activities in Alberta (80-15-SIM)
   H.P. Sims, Alberta Environment

Reclamation and reclamation research activity in Alberta were surveyed and presented in report form.

Status: Completed

Results: Published in Report #RRTAC 81-2

3. Cross Reference for Reclamation Review (80-13-WAL)
   D.G. Walker, David Walker Assoc. Ltd.

This project will provide a cross reference of keywords, authors and subjects as part of the Reclamation Review.

Status: Completed

Results: Published in Report #RRTAC 82-1

4. Species Suitability Manual (79-5-W/P)
   L.E. Watson, Techman Ltd.

This manual catalogued available information on the many species used

or useable in reclamation. This will help Reclamationists design seed mixes which are better adapted to their particular needs.

Status: Completed

Results: Published Report #RRTAC 80-5 Vol. I Grasses
Vol. II Forbs, Shrubs and Trees

PLAINS AGRICULTURAL LAND

OBJECTIVE: Restoration of Agricultural Capability

PROBLEM AREA	RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1983 RRTAC EXPENDITURES	INDUSTRY INVOLVEMENT
Groundwater/ Geology	- Effects of Mining on groundwater supplies - Generation of Salts in Spoil - Transport of Salts near the Reclaimed Soil Surface - Subsidence after Reclamation - Effects of underground Ash disposal on groundwater - Overburden classification	79-2-MOR 79-22-HOD* 79-27-HOD* 80-14-MAR*	The Regions including and surrounding the Battle River and Highvale Mining areas are being intensively monitored to assess the effects of mining on the Soil, Water and ultimately, the Agricultural Resources. As significant concerns are identified remedial measures are also evaluated. Monitoring is in the third of five years at Battle River and in the first of five years at Highvale.	3,493,817	Joint Management and Project Review through Project Steering Committee, Site Access and information sharing: Alberta Power Ltd. Manalta Coal, Luscar Ltd. and TransAlta Utilities
Soil Reconstruction	- Thickness of Subsoil required above Sodic Spoil - Effects of Slope on lateral salt transport - Reconstruction of Solonetzic Soils - Use of Bottom Ashes Soil Amendment - Effects of different Crops on thickness requirements - Changes in Topsoil during stockpiling	82-5-LES 82-13-SCH 79-6-SCH* 79-26-FUJ	Experimental Plots have been constructed on the Battle River and Highvale Mine areas and 1983 will be their second and first crop years respectively. The Plots will be intensively monitored annually for five crop years each.	332,167	Plot Construction; Joint Management and Project review through Project Steering Committee: Alberta Power Ltd., Luscar Ltd., Manalta Coal and TransAlta Utilies
Fly and Bottom Ash Disposal	- Chemical and Physical Properties of Alberta Fly & Bottom Ashes - Potential for use as Soil Amendment	78-2-MCC* 78-20-MCC* 78-5-P/R* 80-19-MCC*	Ashes from five Alberta Sources were analyzed for both toxicity and Soil Amendment possibilities. This Program is completed and the results are published in Report #RRTAC 81-3.	12,176	Provision of Ash Samples: Alberta Power Ltd., TransAlta Utilities and Saskatchewan Power Ltd.
Pipelines	- Identify the best methods for handling Soil materials in pipeline construction in Agricultural land	81-1-HAS*	A Survey was made of Pipelines of various ages on all of our major Agricultural Soil types. Material handling methods were assessed and problem areas identified.	40,120	A member of the pipeline Industry sat on the Project Mgm't. Committee access to construction records route locations and demonstrations.
				3,878,280	

* Completed Projects

MOUNTAIN AND FOOTHILLS COAL MINING

OBJECTIVE: Restoration of Forestry, Wildlife and Watershed Capabilities

PROBLEM AREA		RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1983 RRTAC EXPENDITURE	INDUSTRY INVOLVEMENT
Landscape Design		Design & Construction of Stable Spoil Dumps	82-14-CHO	Survey of Existing Reclaimed Dumps in Alberta and British Columbia to identify Practical Resloping Strategies	10,137	Information sharing on site demonstrations
		Water Management				
Soil Reconstruction		For Commercial Forestry Potential	Company Projects Coal Valley Luscar-Sterco Ltd.	Forest Soil Reconstruction Plots, White Spruce and Lodgepole Pine planted on various reconstructed soil profiles.	0	100% Funding Luscar Ltd.
			Obed-Marsh, Union Oil of Canada Ltd.		0	100% Funding Union Oil
		For Erosion Control on Ash Dumps	79-1-MAC	Thickness of Soil required over Bottom/Fly Ash mix to support vegetation	50,371	Plot Construction and design McIntyre Mines
Revegetation	Herbaceous Cover	Species Selection	79-7-WEI 79-23-WEI 82-12-TOM 79-5-W/P 79-18-RUS	Development, assessment and Field Testing of Native Grasses for reclamation. Presentation of known information on Species for Reclamation	572,333	-
		Erosion Control	79-17-TAK 80-11-TAK 78-1-LAR* 82-9-LLO*	Mulches, Binders & Contouring Techniques for erosion control on coal spoil	17,475	-
		Fertilization, Nutrients	82-11-Z/T 78-3-M/P 79-8-L/R	Identification of Treatments important to development of self-sustaining Plant Cover	32,453	-
	Tree & Shrub Cover	Propagation	80-16-KIN 82-1-K/H	Propagation of Shrubs of Reclamation	20,181	-
		Establishment	79-16-MIH	Establishment of Tree Seedlings in Grass Cover	0	-
					702,950	

OIL SANDS

OBJECTIVE: Restoration of Forestry, Wildlife Capabilities and Erosion Control

PROBLEM AREA	RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1983 RRTAC EXPENDITURES	INDUSTRY INVOLVEMENT
Soil Reconstruction on Tailings Sand	Identify Recipies for Reconstructed soils suitable for: - Commercial Forest - Non-Commercial Forest - Erosion Control/ - Wildlife Habitat	78-4-PAR* 79-24-OSE* 81-2-PAR 81-3-PAR*	Identification of the chemical and Microbiological properties of peat, development of micorrhizal innoculants for Jack Pine and other woody species, identification of amendment level requirements. These studies are largely complete and were fundamental in designing the Oil Sand Soil Reconstruction Plots which will begin construction in 1983.	534,611	Joint Project Development Management, review and 80% Funding of 79-24-OSE. Provision of test site for 81-2-PAR
Revegetation	Shrub & Tree - Selection - Propagation - Establishment - Management	79-13-DUN 81-4-P/F* 81-5-WAT* 81-6-K/K* 81-7-ROW*	These projects consist of Tree and Shrub selection, Seed collection, development of Propagation Techniques, and Sampling Methods for use on the Soil Reconstruction Plots to be constructed in 1983.	14,499 549,110	Project development, Joint/Management, review and 50% Funding of 81-4,5,6, 100% Funding of 81-7 ROW
Equipment Development	For Incorporation of Tailing Sand Amendments (e.g. Peat, Clay)	(No Formal Projects or Contracts were commissioned under this priority. Rather Government and Industry staff have jointly reviewed available equipment and have arranged trials under operational conditions. The evaluation is continuing)			
GENERAL **					
Reclamation Review	Document the Findings Reclamation Research activities and assess implications for Alberta operations	78-6-SIM 79-20-WAL 80-15-SIM 80-13-WAL	World wide Reclamation Literature has been reviewed and condensed for presentation in a Report which will list and discuss existing information as pertinent to Reclamation in Alberta. The data base is accessable through The University of Alberta computing system. See Reports #RRTAC 82-1- and 81-2.	69,323	
				69,323	
	Total for all RRTAC Programs as of 31 March, 1983			5,199,663	

** Projects with Province wide application

LOCATION OF FIELD PLOTS

PLAINS

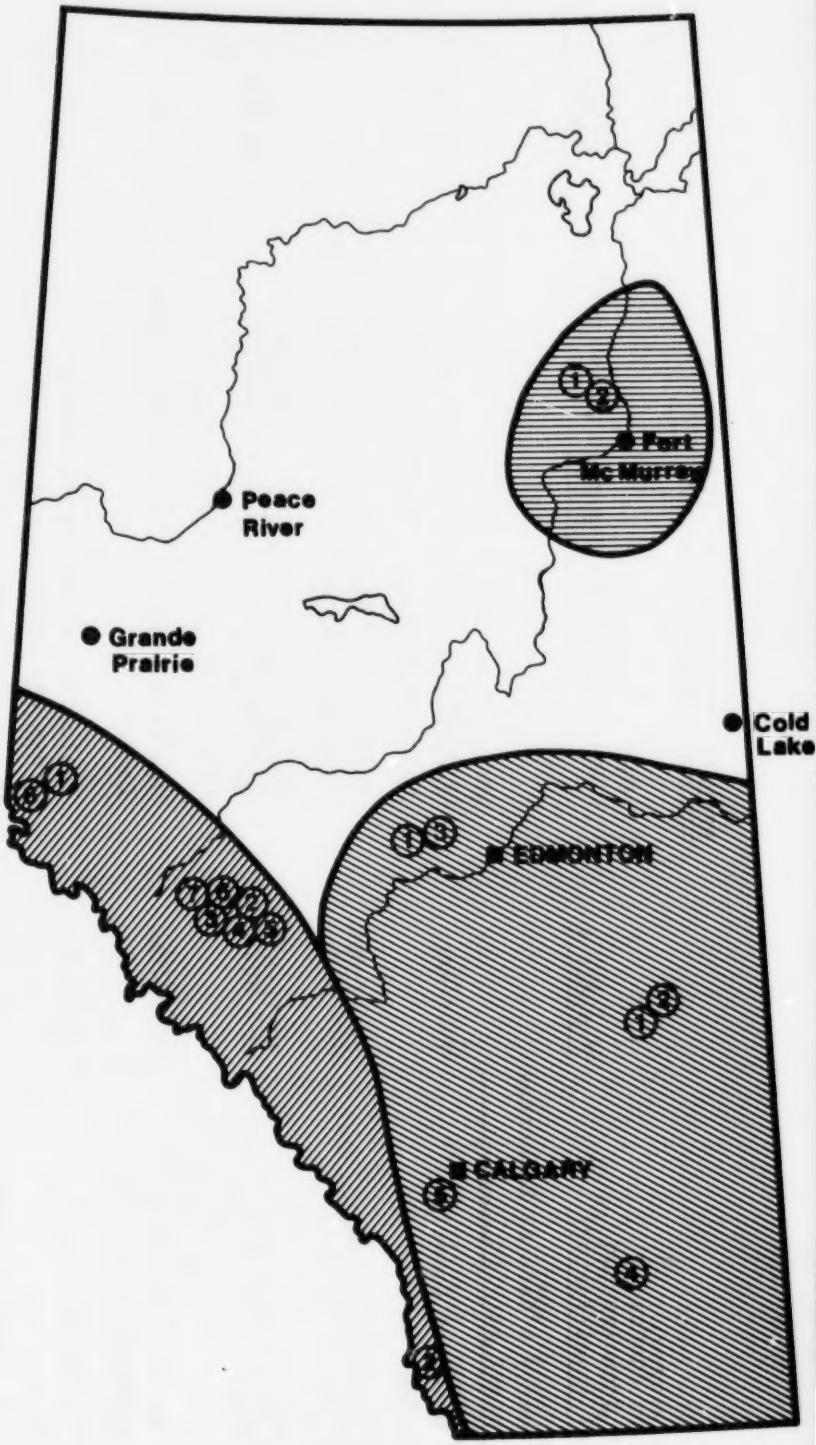
1) 79–2–MOR FORESTBURG, HIGHVALE.
2) 82–5–LES FORESTBURG.
3) 82–13–SCH HIGHVALE.
4) 79–26–FUJ BOW CITY.
5) 78–4–PAR CALGARY.

MOUNTAINS & FOOTHILLS

1) 79–1–MAC GRANDE CACHE.
2) 79–16–MIH COALVALLEY, CROWSNEST.
3) 79–17–TAK CADOMIN.
4) 79–18–RUS CADOMIN.
5) 80–11–TAK CADOMIN.
6) 79–23–WEI CADOMIN, GRANDE CACHE.
7) 82–11–Z/T CADOMIN.

NORTHEAST OIL SANDS

1) 81–2–PAR MILDRED LAKE.
2) 79–13–DUN MILDRED LAKE.



RESEARCH PROJECTS 1982-83

Managing Agency (Research Organization Principal Investigator)	Project #	Research Subject	RRTAC Budget # (1982-83)
Alberta Energy & Natural Resources Alberta Forest Service			
(Alberta Research Council T.M. Macyk)	79-1-MAC	Revegetation of Ash Disposal Pits, McIntyre Mines, Grande Cache	19,260 1
(Alberta Forest Service S.K. Takyi, P. King)	79-13-DUN	Selection of Woody Plants for Oil Sand Reclamation	0 2
(Alberta Forest Service P. King)	79-16-MIH	Establishment of Tree and Shrub Seedlings in Erosion Controlling Cover, Coal Valley, Crowsnest	0
(Alberta Forest Service S.K. Takyi)	79-17-TAK	Use of Mat Mulches on Difficult Slopes, Cadomin	0
(Alberta Forest Service H. Tomm)	79-18-RUS	Evaluation of Native-Agronomic Grass and Legume Mixes, Cadomin	0
(Alberta Forest Service S.K. Takyi)	80-11-TAK	Methods of Establishing Native Grass on Unamended Coal Spoil, Cadomin	0
(Alberta Forest Service P. King)	80-16-KIN	Native Shrub Seed Propagation Testing Project	3,000
(Techman Ltd. R. Hermesh)	81-5-WAT	Shrub Propagation Literature Review	7,475
(University of Alberta Forestry Department C. Keating)	82-1-K/H	Factors Affecting Germination of Buffaloberry	15,181
(Mihajlovich Environmental Services Ltd. M. Mihajlovich)	82-12-TOM	Survey of Native Grass Plantings	7,500

Managing Agency (Research Organization Principal Investigator	Project #	Research Subject	RRTAC Budget # (1982-83)	
Alberta Energy & Natural Resources				
(Scientific & Engineering Services P.F. Ziemkiewicz/S.K. Takyi)	82-11-Z/T	Development of Stable Nutrient Cycles on Subalpine Coal Spoil	6,755	
(Scientific & Engineering Services P.F. Ziemkiewicz)	79-23-WEI	Selected Lines of Native Grasses Alpine and Subalpine Test Plots	0	
(Public Lands Division D. Lloyd)	82-9-LLO	Erosion Control for Sandy Sites	11,330	
(Coal Mining Research Center R. Chopiuk)	82-14-CHO	Survey of Mountain Waste Dumps and Resloping Operations	10,137	
Alberta Environment Research Management Division				
(Research Management Division H.P. Sims)	78-6-SIM	Review and Presentation of Reclamation Information Pertinent to Alberta	0	
(Alberta Research Council S.R. Moran)	79-2-MOR	Hydrologic Impacts of Plans Surface Coal Mining, Forestburg, Highvale	1,099,963	
(Alberta Environmental Technical Development Branch C. Palmer)	79-6-SCH	Techniques for Restoring Crop Production after Surface Mining, Forestburg - Remaining Soil Analyses from 1981-82	4,132	3
(Genetics Dept., University of Calgary/Alberta Environmental Center J. Weijer/A. Naeth	79-7-WEI	Development of Native Grasses for Reclamation	79,540	4
(Biology Dept., University of Calgary D. Parkinson)	81-2-PAR	Micorrhizal Development in Reconstructed Soils	116,700	

Managing Agency (Research Organization Principal Investigator	Project #	Research Subject	RRTAC Budget # (1982-83)
(Pedology Consultants Ltd. L. Leskiw)	82-5-LES	Battle River Soil Reconstruction Project	130,000
(Montreal Engineering Co. Ltd. A. Schumacher)	82-13-SCH	Highvale Soil Reconstruction Project	25,169
Alberta Environment Technical Development Branch			
(Technical Development Branch J. Fujikawa)	79-26-FUJ	Physical and Chemical Changes in Stockpiled Topsoil	0
		TOTAL	1,536,142

1/ Cooperatively funded with McIntyre Mines Ltd.
2/ Projects requiring no RRTAC Budget are fully funded by the Managing Agency
3/ Cooperatively funded with Alberta Power Ltd., Luscar Ltd. and Manalta Coal
4/ Cooperatively funded with Parks Canada

LAND CONSERVATION

AND

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